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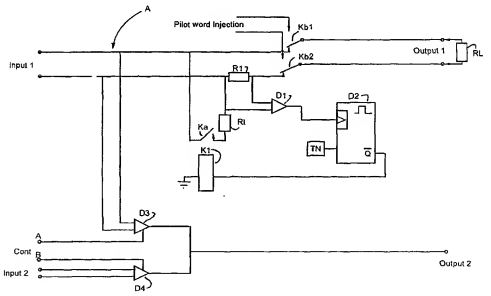
(54) **Title:** DIGITAL DATA SPLITTER WITH SWITCH AND AUTOMATIC TERMINATION RESTORATION



(57) **Abstract:** A digital data splitter is disclosed. The digital data splitter has a main bearer and a protection bearer. The main bearer is normally terminated by a system termination and a sensing component is connected to the main bearer for sensing current. A control circuit is operative to connect a termination element across the main bearer when system termination is lost. A splitter circuit functions to connect the data on the main bearer to the protection bearer when system termination is lost and to allow itinerant data to be applied to the protection bearer when the main bearer is terminated by the system termination.

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DIGITAL DATA SPLITTER WITH SWITCH AND AUTOMATIC TERMINATION RESTORATION

The invention relates to a digital data splitter with switch and automatic termination restoration. In particular, the invention relates to improvement in protecting digital data streams using a redundant or protection bearer and the use of amplifiers to split one data stream into two equal streams to accomplish transmission of redundant data via the protection bearer.

BACKGROUND ART

Current systems use either one single amplifier with two equal, in-phase outputs or two separate amplifiers with a common input and equal, in-phase outputs to derive a desired splitting effect. In order for these methods to be effective with very high data rate transmissions, the input to the amplifier/s must be terminated with the correct impedance and the outputs must be sufficiently isolated not to cause interaction. This known system requires the use of high frequency by-pass relays to obviate total system failure in the event of a power supply failure.

Another known system uses a single high impedance input buffer parallel fed with the input data stream. Two outputs are then available, one from the non-buffered output and the other from the buffered output. At high data rates and therefore high frequencies, no input terminators are required if the non-buffered output is continuously terminated employing the system impedance. This system suffers when the non-buffered output termination is removed. At high data rates this causes severe reflections and distorts the data available to the buffer amplifier. The buffer amplifier is not able to compensate for the termination loss and therefore both the buffered and non-buffered outputs are rendered useless.

The data is extracted at the receive end by either a high frequency relay or by switched amplifiers to select either data stream.

These known systems only allow for a single input and two

equal, in phase outputs. These data splitters allied with a receive changeover switch allow the data streams to be split and with the use of a redundant bearer between terminal points, provide complete protection for the transmitted data. However, this requires the total commitment of the redundant or protection bearer for protection and gives rise to wastage of potential capacity between the two terminals.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a digital data splitter with switching and automatic termination restoration which at least minimises the disadvantages referred to above.

The system of the invention provides for data protection via a redundant bearer and for means for accessing the redundant bearer on an itinerant basis for increasing available bandwidth by using a partially active transmit splitter incorporating automatic termination restoration that provides for power fail continuity and termination removal. The splitter preferably incorporates an extra input via a second buffer amplifier.

According to one aspect the invention provides a digital data splitter with switch and automatic termination restoration, the splitter including a sensing component in series with a main bearer normally terminated by a system termination, a termination element coupled to a control circuit, the control circuit being responsive to the sensing component to connect the termination element to the main bearer a protection bearer for itinerant data and a splitter circuit for selective coupling either the data on the main bearer or from itinerant data to the protection bearer.

The sensing component may be an impedance device for sensing current in the terminated main bearer. Preferably the sensing component is a sensing resistor.

The termination element is preferably a load identical to the termination load employed to terminate the main bearer. Preferably, the termination element is a termination impedance.

The control circuit may include a comparator having its inputs

coupled to opposite ends of the sensing component and a retriggerable monostable flip-flop with its clock input coupled to the output of the comparator. A timing network is coupled to a timing input of the monostable flip-flop. An output from the flip-flop is coupled to a relay coil for operating a relay to couple the termination element to the main bearer in the event that termination of the main bearer is lost.

The splitter circuit includes two buffers controllable to connect either the signals from the main bearer to the protection bearer when the system termination employed to terminate the main bearer is lost or to apply itinerant data to the protection bearer when the main bearer is normally terminated by the system termination.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of the invention will now be described by way of example with reference to the drawing in which Figure 1 is a block diagram of a digital data splitter with switch and automatic termination restoration according to an embodiment of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Figure 1 shows the transmit section of a splitter of an embodiment of the invention. Digital data may be presented at input 1 and input 2. The lines terminated by load impedance or system termination RL represent the main bearer. The data line at which "output 2" may be available represents a protection bearer.

Data presented at input 1 is coupled to amplifier D3 and to the load impedance RL at output 1. Amplifier D3 is a high impedance buffer amplifier with a disable input. Data presented at input 2 is connected directly to amplifier D4 which is also a high impedance buffer amplifier with a disable input. The outputs of D3 and D4 are together coupled to output 2. Amplifiers D3 and D4 are enabled or disabled by a control input at terminals A and B. Either amplifier D3 or D4 is enabled and when one is enabled the other is disabled. These amplifiers cannot be enabled at the same time but both

amplifier D3 and amplifier D4 may be disabled at the same time.

Sensing resistor R1 is connected in series with one of the connections from input 1 to output 1 but is located after the connection point A which connects amplifier D3 to the data lines and after the connection point for relay contacts Ka and resistor Rt. Resister R1 senses the current flow through the load RL. This current flow causes a voltage drop across resistor R1 which is detected and amplified by comparator D1. The resulting output logic stream from D1 is connected to the clock input of retriggerable mono-stable flip-flop D2. These pulses keep D2 triggered and the complementary output of flip-flop D2 is kept at logic 0. If the system termination RL is removed then the current flow through R1 ceases. This forces flip-flop D2 to the reset state after the period set by the timing network TN.

The resetting of flip-flop D2 operates relay coil K1 and contact Ka which connects load Rt across the input 1 terminals. This load Rt is effectively connected across the inputs to amplifier D3 and this maintains the system termination in order to prevent distortions at the input to amplifier D3. Reconnection of the system termination RL causes flip-flop D2 to be set and the relay coil K1 and contact Ka to be released thus preventing double termination.

Amplifiers D3 and D4 are under the control of logic circuitry (not shown) and the amplifiers determine the content of "output 2" as either data from input 1 (when D3 is enabled and D4 is disabled) or data from input 2 (when D4 is enabled and D3 is disabled).

The splitter of the invention is a partially active device which allows itinerant access to the protection bearer (output 2) with automatic termination restoration. The splitter accomplishes the split and protection access control by using high speed, high impedance operational amplifiers with a disable function. The splitter terminates the input to the amplifier D3 for the main bearer access of the protection bearer by the use of a sensing element in series with one line of the main bearer and presents this sensed data to the control circuitry.

The control circuitry includes a high speed differential

comparator D1 coupled to the clock input of the resettable monostable flip-flop D2. Flip-flop D2 has a timing network TN associated with it which determines how long the system termination is removed before automatic retermination is activated. The automatic retermination is accomplished by high frequency relay K1 connected to the complementary output of the resettable monostable flip-flop D2 to connect a termination equivalent to the system termination across the input to the main bearer access amplifier D3.

Figure 1 shows the way in which digital words such as a PILOT word may be applied to the main bearer. In this figure the main bearer which extends between input 1 and output 1 consists of two balanced lines. These lines have contacts Kb1 and Kb2 which may be switched by a relay (not shown) between the position shown which allows data to be applied to the main bearer and the other position which allows the PILOT word to be injected onto the main bearer.

Input 2 in figure 1 is a balanced input whilst output 2 is an unbalanced output. This unbalanced output may be converted to a balanced output by use of a transformer (not shown).

CLAIMS

1. A digital data splitter with switch and automatic termination restoration, the splitter including a sensing component in series with one of two terminated data lines providing a main bearer normally terminated by a system termination, a termination element coupled to a control circuit, the control circuit being responsive to the sensing component to connect the termination element to the main bearer, a protection bearer for itinerant data and a splitter circuit for selectively coupling either the data on the main bearer or the itinerant data to the protection bearer.

2. The digital data splitter of claim 1 wherein the sensing component comprises an impedance device in series with the main bearer for sensing current on the main bearer.

3. The digital data splitter of claim 1 wherein the termination element comprises a termination impedance.

4. The digital data splitter of claim 2 wherein the control circuit includes a comparator having its inputs connected to opposite ends of the sensing component and a retriggerable monostable flip-flop with its clock input coupled to the output of the comparator and a timing network connected to a timing input of the monostable flip-flop for resetting the flip-flop after a predetermined time period when current is no longer sensed by the sensing component.

5. The digital data splitter of claim 4 including a relay coupled to an output of the flip-flop for connecting the termination element to the main bearer in response to resetting of the flip-flop.

6. The digital data splitter of claim 5 wherein the relay is coupled to the complementary output of the flip-flop.

7. The digital data splitter of claim 5 wherein when the system termination is restored causes the flip-flop to be set and the relay is released to thereby prevent double termination.

8. The digital data splitter of claim 1 wherein the splitter circuit includes two controllable buffers with the first said buffer having its inputs coupled to the main bearer and the second said buffer having its inputs

adapted to receive itinerant data, the outputs from the buffers being coupled to the protection bearer.

9. The digital data splitter of claim 8 wherein each of the buffers has a control input and the buffers are controlled to either couple data on the main bearer or itinerant data to the protection bearer.

10. The digital data splitter of claim 9 wherein when the sensing component senses current, the buffers may be controlled to allow itinerant data to be coupled to the protection bearer and when current is not sensed by the sensing component the buffers are controlled to couple the main bearer data to the protection bearer.

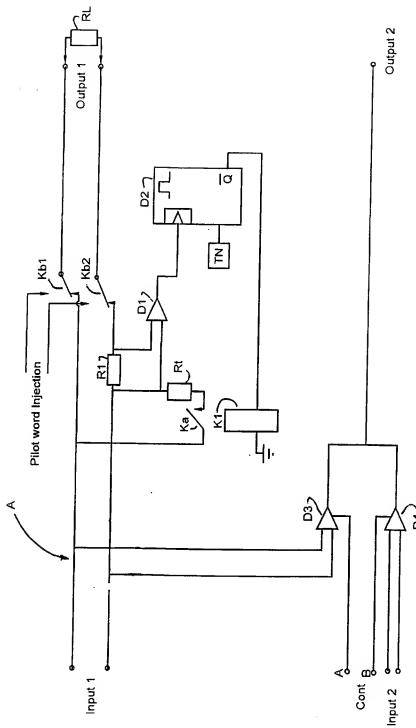
RL
Output 1
Output 2
D2
Q
TN
Kb1
Kb2
D1
R1
Rt
Ka
K1
Pilot word Injection
A
D3
D4
Input 1
A
Cont
B
Input 2

Figure 1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 01/00289

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl[7]: H04L 29/02, H04B 3/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC : GLOBAL

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
INTERNET

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPAT

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5757803 A (RUSSELL et al) 26 May 1998 whole document	1-10

☐ Further documents are listed in the continuation of Box C

☒ See patent family annex

* Special categories of cited documents:

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 April 2001	8 May 2001
Name and mailing address of the ISA/AU	Authorized officer
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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/AU 01/00289

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member		
US	5757803	AU 10797/97	EP 864219	WO 9720296

END OF ANNEX